BOLD DELIVERS

Department of Health

Final Report - Evaluation of the Operation and Effectiveness of COVIDSafe and the National COVIDSafe Datastore

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Submitted to:
s22
Department of Health
Canberra, ACT

Submitted by:
Abt Associates
Level 2, 5 Gardner Close
Milton, Brisbane QLD, 4064 Australia

Contact:
s47F

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Acronyms and Abbreviations

Abt	Abt Associates (Australia)
ACSC	Australian Cyber Security Centre
AHPPC	Australian Health Protection Principal Committee
app	(mobile device) application
BCG	Boston Consulting Group
BLE	Bluetooth Low Energy
CDNA	Communicable Disease Networks Australia
COVID-19	Coronavirus Disease of 2019
DoH	Department of Health
DTA	Digital Transformation Agency
NSW	New South Wales
PHU	Public Health Units
PHO	Public Health Official
QLD	Queensland
QR	Quick Response
RSSI	Received Signal Strength Indicator
SoNG	Series of National Guidelines
SARS-CoV-2	Severe Acute Respiratory Syndrome Corona Virus 2 (strain)
VIC	Victoria

Executive Summary

In late September 2020, Abt along with technology partner Bdna, were commissioned to evaluate the operation and effectiveness of the COVIDSafe app and the National COVIDSafe Datastore. The evaluation would inform a six-monthly report to be tabled in parliament under Section 94ZA of the *Privacy Amendment (Public Health Contact Information) Act 2020*.

A mixed-methods approach was used drawing on public health evaluation and technology review methodology to examine available evidence on the appropriateness, effectiveness and efficiency of COVIDSafe. The evaluation focuses on the three states with the highest number of COVID-19 cases in the country: New South Wales, Victoria and Queensland.

Appropriateness

At the time of COVIDSafe development, there was an increasing recognition that to keep pace with a novel virus of such rapid spread the well-proven system of standard contact tracing would benefit from further strengthening by leveraging technological innovations.

Stakeholders agreed that the intended objective of the app which focused on providing safeguards to open the economy were beneficial. All stakeholders acknowledge the challenges at the time of the app development, which involved producing a new digital contact tracing tool, for a new virus, and in a context of evolving epidemiological and technological evidence. To do it in a matter of weeks and under intense public scrutiny to safeguard both public health priorities and individual privacy rights was a commendable achievement.

That developing COVIDSafe was the right thing to do is reflected by the high evidence-based score given to the app by both the Institute of Public Affairs and Per Capita analysis of quality of emergency decision-making in the country. Both studies found COVIDSafe to apply best-practice and along with the JobKeeper scheme, the app topped the ranks of emergency decision-making in both studies.

From a technology perspective, **the COVIDSafe app was the correct tool to employ based on the parameters of knowledge and capabilities at the time of app launch**. Many of the international contact tracing apps, such as Singapore's TraceTogether, similarly utilised Bluetooth Low Energy (BLE) to capture digital 'handshakes' between mobile devices. The extent of the limitations of utilising BLE technology (discussed further in the report) to perform contact tracing for the COVID-19 situation were not known at the time of app launch because this particular use of the technology did not yet exist. Developing a BLE solution was also especially attractive at the time because user privacy was paramount, so privacy intrusive alternatives (such as geolocation trackers) were considered but a decision was made that these alternatives were not suitable to protect user privacy.

Effectiveness

Digital Transformation Agency (DTA) data (for the period 18 March to 13 October 2020) shows a large number of people (7,122,061) have voluntarily installed the COVIDSafe app and registered it. Most users of COVIDSafe reside in NSW (33%), VIC (29%), and QLD (18%) with the remainder of the states making up the last 20%.

During the second half of 2020, NSW provided 'ideal' conditions to evaluate the effectiveness of the app (an open economy with moderate to high potential transmission). In NSW, the total number of true close contacts identified by the app represents 1.3% of the total pool of close contacts identified in NSW, (tolerance 0.8% – 1.8% under different scenarios). In Victoria, state data shows that out of the 12,609 cases with COVIDSafe information recorded, 1,833 cases (15%) reported using the app versus 10,776 cases (85%) reporting no app-usage. Victoria also provided data on the number of close contacts identified by the sub-sample of app-using cases (9,402 close contacts recorded for 1,833 app-using cases). In all Victorian cases they were all recorded as individuals already identified by standard contact tracing with **no novel contacts identified through the app**.

During the second wave of the pandemic, Queensland closed state borders and progressively relaxed social and mobility restrictions for its residents. The state showed very low levels of community transmission with only 60 confirmed cases locally or inter-state acquired between 1 May and 15 November 2020. The contact tracing team identified 4,273 close contacts, that is an average of 71 per case. **Less than five cases were reported by**

Queensland Health as using the app in the data provided and no novel contacts were identified using the app. For the sub-sample of cases over 18 years of age (48), this represents a proportion of app-using cases in the range of two and eight percent.

COVIDSafe Limitations

The COVIDSafe app utilises BLE technology, cryptography, operates independently on a user's device and does not require any integration with other apps to perform its function. However, our technology review suggests there are some important technology constraints that might have contributed to the level of app effectiveness.

The COVIDSafe app relies on users selecting the right phone settings for both iOS and Android devices. On Android and iOS devices, the COVIDSafe app is not able to function properly (i.e. register handshakes) without having Bluetooth enabled, this is also true of the COVID-19 Google and Apple Exposure Notification Framework (ENF) and so is a challenge for all Bluetooth contact tracing apps.

For Android phones, location services also need to be enabled and for all phones the app either needs to be open and active or running in the background. This means there is a level of user compliance required as a pre-requisite for the app to work effectively and this has not always occurred and is an inherent risk for the effective operation of COVIDSafe. s47C, s47E(d)
s47C, s47E(d)

The iOS operating system has several inherent limitations including a security feature implemented by Apple which prevents apps from constantly running Bluetooth in the background if that data is going to be moved off device.
s47C, s47E(d)

s47C, s47E(d) Abt also observed during our interviews that state contact tracing teams identified very high-risk settings (indoor venues such as restaurants, bars and nightclubs as well as large unstructured outdoor events such as music festivals, food festivals, carnivals, and other un-ticketed spectator events) as a key priority gap in standard contact tracing that would need the support of digital tracing tools, such as attendance registration apps or COVIDSafe like technology options. However, in its current form, COVIDSafe is not able to be used effectively for these purposes due to the identified constraints discussed in this report.

The app has identified less than two percent of the total pool of close contacts identified in NSW and no new contacts were identified by COVIDSafe in Victoria or Queensland between March and November 2020. COVIDSafe has technology constraints, complications with manufacturer phone settings, and there are limitations to its use in high-risk settings. Overall, the state contact tracers interviewed for this report have suggested it has not been a highly effective complementary tool for their state contact tracing systems.

Efficiency

During our interviews, the primary users and beneficiaries of COVIDSafe, the state contact tracing teams, have noted that the time required to undertake the various COVIDSafe tasks adds to their workloads without an optimisation of benefits. Contact tracers reported that they mainly use COVIDSafe to quality assure manual tracing efforts at the end of the standard contact tracing interview. When asked if COVIDSafe could be used higher up in the interview process, all states unanimously suggested this was not possible due to a lack of app data for the majority of potential contacts. Available data from NSW examined show that out of 205 individuals flagged by the app, 61% (126) were 'false close contacts', 30% (62) were individuals already identified by standard contact tracing and the remaining 8% (17) were novel contacts. These inefficiencies arise because while all app potential contacts need to be validated by contact tracers, a significant number of those individuals are either 'false close contacts' or individuals already identified by standard contact tracing. This is compounded by existing processes to access datastore information.

Due to stringent privacy protections and without a data exchange facility, all information needs to be examined on screen by contact tracers and manually entered into the jurisdictional systems or spreadsheets. Contact

tracers are not able to download the data, automate or match information with their state systems to analyse and validate information in a less cumbersome way.

In the current environment, where public health units must be ready to rapidly surge their capacity and where it is widely acknowledged that experienced contact tracers are at the core of a good system and cannot be easily outsourced or secured through short term training, inefficient use of contact tracers' time is a high cost for the system to bear. Since experienced contact tracers are currently in high demand and face scarce supply, any additional task required from them that does not deliver substantial benefits carries considerable opportunity costs.

Overall, the utilisation of COVIDSafe has resulted in high transaction costs for state contact tracing teams and produced few benefits and efficiencies to the existing contact tracing work-flow.

Conclusion

As countries around the world grappled with the dire economic consequences of lockdowns, there was increasing recognition that as economies started opening again, digital tools were required to support contact tracers and effectively manage the pandemic. Almost a year later, the s47C call for end-to-end contact tracing that never falls behind reinforces this vision of leveraging technology capabilities to support an effective test and trace system.

From a technology perspective, the COVIDSafe app was the correct tool to employ based on the knowledge and capabilities at the time of app launch. Many of the international contact tracing apps, utilised Bluetooth technology to capture digital 'handshakes' between mobile devices.

While the tool used appropriate technology and there have been several notable improvements to the app and datastore since it was launched, from the perspective of state contact tracers who are the beneficiaries or customers of the app, there are limitations in both the effectiveness and efficiency of COVIDSafe for contact tracing efforts.

We acknowledge that even with a vaccine, COVID-19 will remain a challenge for some time and in this context, we believe it is crucial for all state and commonwealth stakeholders to explore options for enhancing COVIDSafe. It is particularly important to the seven million Australians that have downloaded the app, to acknowledge the performance barriers that are limiting the effectiveness and efficiency of COVIDSafe.

We hope these evaluation findings can be used to inform discussions with state contact tracers on future improvements to COVIDSafe. We further advise that noticeable improvements to COVIDSafe should occur and be demonstrated through the continued involvement of states and territory public health officials in user testing (the workflow of the datastore, integrations with state contact tracing systems and the utility of the app), to ensure continued support of the app.

Introduction

With the COVID-19 pandemic creating havoc around the world, in April 2020 the Department of Home Affairs was considering developing a contact tracing app, based on one already in use by the Singaporean government called TraceTogether. The Commonwealth government decided that to be successful in the Australian context, the app needed to be voluntary; have a strict focus on health; reassure the public that it would not track the location of citizens; and have robust privacy and security safeguards built in. The policy side of the app was transferred to the Department of Health (DoH) from the Department of Home Affairs and the Digital Transformation Agency (DTA) provided high level product development guidance. The DTA team was tasked to develop a new digital contact tracing tool in a matter of weeks and under intense public scrutiny that would support contact tracing efforts as economic restrictions were lifted. This culminated in the development of the COVIDSafe App.

At the time of launch the intended objective of COVIDSafe was to support Public Health Units (PHUs) as a complementary tool to their manual tracing processes. The rationale was that as lockdowns were coming to an end and as people resumed their normally active lives, confirmed cases might not easily be able to recall or even know the people they were subsequently in close contact with. The app was launched on 26 April 2020 and the Prime Minister's press release[1] detailed all the privacy considerations that would allow Australians to download the app confidently in the knowledge that the government would not use the app to track their location and that their personal data was securely protected.

In late September 2020 Abt along with technology partner Bdna were commissioned to evaluate the operation and effectiveness of the COVIDSafe app and the National COVIDSafe Datastore. The evaluation would inform a six-monthly report to be tabled in parliament under Section 94ZA of the *Privacy Amendment (Public Health Contact Information) Act 2020*.

A mixed-methods approach was used drawing on public health evaluation and technology review methodology to examine available evidence on the appropriateness, effectiveness and efficiency of COVIDSafe. Our evaluation focuses on three states, New South Wales, Victoria and Queensland, chosen in consultation with the Department of Health as the states with the highest number of COVID-19 cases in the country and with PHUs who most use the datastore.

Out of scope aspects of the evaluation included other health aspects of the response to the COVID-19 pandemic as well as privacy issues that have been evaluated separately. The review team consulted with state and territory public health authorities who are responsible for contact tracing s47C, s47E(d)
s47C, s47E(d)

s47C, s47E(d) Additionally, only publicly available updates to COVIDSafe, such as those discussed in the media have been examined and illustrate the Commonwealth's commitment to continuous improvement[3].

The findings presented in this report are subject to the limitations and assumptions of the data, including differences identified between Commonwealth and State data sources. The evaluators have sought to identify and minimise, to the greatest extent possible, these limitations. While the analysis is firmly based on best practice and has been subjected to rigorous quality assurance procedures, ongoing developments and improvements in data may potentially produce different results in different components of the analysis.

Contextual Background for COVIDSafe Development

Throughout the COVID-19 pandemic, governments across the world have been grappling with difficult choices in the middle of uncertainty. Under normal circumstances, we deal with uncertainty by gathering additional

information, but these were not normal circumstances. Constantly emerging new knowledge about the epidemiology of the virus[4] and lack of consensus amongst experts as to which specific strategies would deliver the best balance of health and economic outcomes[5] have been the 'new norm' under COVID-19.

Policymakers have had no option but to make decisions in the context of uncertainty, without knowing the level of outcomes that could be expected and the associated probabilities that would occur. Unfortunately, not even the best fine-tuned and state of the art epidemiological and behavioural models could have addressed each and every single question that needed an answer. The recent discussions about vaccines[6] is just one example of the enormous challenge that this unchartered territory poses to even the most judicious policy-makers set on following the science and working in close collaboration with teams of epidemiologists, modellers and other scientists.

At the time of COVIDSafe development, there was increasing recognition that to keep pace with a novel virus of such rapid spread as mobility and social restrictions were lifted, the well-proven system of standard contact tracing would benefit from further strengthening by leveraging technological innovations.[7] Government officials' concerns about the enormity of the risk of opening the economy without safeguards, such as those provided by digital contact tracing supports, reflected broader concerns shared by academics about the risks posed by the so-called exit strategies that allow countries to lift economic restrictions such as lockdowns. [8] Modelling by the University of Melbourne[9] showed that an unmitigated pandemic would rapidly overwhelm the health system capacity in Australia and although the economy has performed much better than expected, this is the largest shock to economic growth since the 1930s and hence the desire to open the economy as soon as feasible. In the next decade it is expected that Australian government debt as a result of the pandemic might be over half a trillion dollars higher than it would otherwise have been.[10]

Early papers based on the best available modelling parameters at the time suggested that delays on standard contact tracing could be substantially reduced with app-based contact tracing, provided of course their modelling assumptions that had never been tested would hold in real life settings [11],[12]. That those modelling assumptions were perhaps excessively optimistic was proven by an August systematic review that found no empirical evidence of the impact of automated contact tracing on metrics such as number of contacts identified and transmission reduction[13]. However, those modelling studies were the best and perhaps the only available evidence at the time. Along the same lines, at the time of launch, the key concern for policymakers was to support contact tracers when cases failed to recall or did not know the names and contact details of those people they had been in close contact with (for example on public transport), which would target encounters that put people at risk of infection due to physical proximity. However, in the coming months strong evidence started emerging that the airborne transmission characteristic of COVID-19 was remarkably efficient and a priority concern in terms of pandemic management as it appeared to be the only plausible explanation for several large outbreaks and clusters in various enclosed settings across the world, which are not the target of proximity apps like COVIDSafe[14].

The success of Australia's management of the pandemic looms particularly large in a world where even advanced economies continue to struggle to contain both the virus spread and economic damage.[15] It has also obscured the enormity of the opportunity costs of not doing the right thing[16], which includes investing in innovations, such as digital contact tracing tools, that showed promising potential to support opening the economy and relaxing restrictions safely.

After factoring in the novelty of the virus and its evolving evidence base; the uncertainty under which decisions had to be made; as well as the vast human, social and economic costs associated with the pandemic, investing in innovations such as COVIDSafe aimed at supporting contact tracing systems across the country was not only the right thing to do, but it also made good economic sense, if only because the costs of 'doing nothing', mounting to billions and even trillions of dollars, were just too large to ignore.

'Doing the right thing' in such an uncertain environment involved delivering innovative interventions, such as COVIDSafe that showed promising potential to deliver large benefits by contributing to the largely successful pandemic response efforts of government. That developing COVIDSafe was the right thing to do is reflected by the high evidence-based score given to the app by both the Institute of Public Affairs and Per Capita analysis of quality of emergency decision-making in the country. Both studies found COVIDSafe to apply best-practice and along with the JobKeeper scheme, the app topped the ranks of emergency decision-making in both studies.[17],[18]

COVIDSafe investments, approximately $16 million in direct costs such as app development and publicity (i.e. excluding staff costs), have been dwarfed by other COVID-19 government investments, such as the [19] $1.1 billion spent since the start of the pandemic in Medicare-subsidised pathology testing for COVID-19[20] and over $3.3 billion directed towards securing a vaccine.[21] With app costs representing less than 0.004% of just these two items, there is not even a suggestion that at the time of the app development taking the risk of investing in a technological innovation such as COVIDSafe was a reckless decision that carried an important opportunity cost for the Commonwealth budget.

COVIDSafe was based on the Singaporean open-source BlueTrace/OpenTrace protocol which uses BLE technology to exchange digital handshakes. These digital handshakes were considered to be a proxy for close contact or physical proximity between two individuals.

Importantly, downloading and using COVIDSafe is also voluntary and a similar privacy-by-design model was adopted with a range of privacy and security safeguards built in. This was in keeping with the Commonwealth Government's requirements to not have location tracking included in the app.

The COVIDSafe website provides detailed information to the public on the various aspects of the app and gives due priority to issues related to user's privacy, including information on the Privacy Amendment passed by Parliament on 14 May 2020, the COVIDSafe Privacy Policy[22] available in 63 languages and the Privacy Impact Assessment was commissioned during the first half of 2020.

Privacy issues are outside the scope of this review (albeit it is a factor of uptake), but suffice to say that available evidence suggests that the robust privacy and security safeguards associated with the app encouraged a large number of Australians to download the app.

A July 2020 study on data trust and data privacy in the COVID-19 period showed that public trust in COVIDSafe associated organisations with regards to data was found to be a strong predictor of the probability of individuals downloading COVIDSafe. [23] Contrary to this finding, but reinforcing the importance of privacy to Australian citizens, the Australian Bureau of Statistics Household Impacts of COVID-19 Survey (June 2020), found that 24% of adults who did not download the app reported concerns for privacy as the primary reason. [24]

Methods

Our evaluation used a mixed-methods and multi-disciplinary approach blending perspectives from public health evaluation and technology reviews to examine available quantitative and qualitative evidence on the appropriateness, effectiveness and efficiency of the COVIDSafe app and the National COVIDSafe Datastore. A high-level technology review was undertaken according to the Request for Quotation which excluded COVIDSafe technological alternatives and recommendations for future innovations. s47C, s47E(d)
s47C, s47E(d)

For our qualitative component, information was primarily gathered through virtual interviews, focus groups and key informant interviews with Commonwealth program partners and state public health offices. Average interview duration was of 60-90 minutes. Discussions were audio-recorded (with consent) and recordings and notes were managed as commercial-in-confidence. We spoke to 19 individual stakeholders and conducted 14 separate interviews (See Appendix 2).

Primary data collection from app users was out of scope and secondary data provided by the DoH, DTA and the three jurisdictions has been used for quantitative analysis.

Queensland provided tabulated information on their number of cases and close contacts with basic demographic breakdown, but without disaggregation by app-usage status due to small numbers. Victoria and NSW provided information on cases, close contacts and app-using cases. They use different proxies to capture app-using cases and provide different levels of granularity, so their individual metrics are not directly comparable.

NSW (Kirby Institute, UNSW & NSW Health) reported in their interim summary evaluation report[34] of COVIDSafe, key metrics for cases over 13 years of age that reported using the app and had it activated at least for some time during their infectious period, but without demographic breakdown.

Victoria provided tabulated data on the total number of cases and the demographic breakdown for cases with app-using information recorded. However, no demographic breakdown for the total sample of cases was available. They also provided information on the number of novel contacts identified by the app for the corresponding sub-sample, but without detailed information on the total number of individuals flagged by the app and whether they were true or false close contacts.

State datasets were triangulated with the information directly provided to the DoH for the second half of 2020, compiled for the researchers by the DoH team in a spreadsheet. We complemented this analysis with an examination of the DTA COVIDSafe report provided in the last week of the evaluation.

The findings presented in this report are subject to the limitations and assumptions of the data, including differences between Commonwealth and state data sources. The evaluators have sought to identify and minimise, to the greatest extent possible, these limitations which could be from the methods used to define and collect the data. While the analysis is firmly based on best practice and has been subjected to rigorous quality assurance procedures, ongoing developments and improvements in data may potentially produce different results in different components of the analysis.

Appropriateness

In this section we examine the operational performance of COVIDSafe within the parameters of knowledge and capabilities at the time of launch. We first set the policy and technology context at the time of app development which provides the framework for our review of the extent to which the app and the datastore operated as intended/designed and whether the technology supported the operational performance of COVIDSafe. A brief discussion of the Singaporean experience is included in Appendix 1.

COVIDSafe Design and Operation

COVIDSafe aims to enhance and supplement the manual process of tracing people who have been in close contact with someone with COVID-19[25], including to verify and prioritise cases. COVIDSafe is a standalone contact tracing app that utilises Bluetooth Low Energy (BLE) technology to record Bluetooth "handshakes" with other nearby COVIDSafe enabled devices.

The Bluetooth handshakes exchange a payload that contains information such as device details, Bluetooth received signal strength (RSSI) and datetime.

To further increase privacy around user identity, an update included functionality to randomly generate a new temporary ID (Temp ID) every few minutes and exchange this in the Bluetooth handshakes instead of a user ID. The only way to decrypt the Temp ID and view the original user ID is once the data is voluntarily passed into the data store.

A close contact is registered by the app when there has been a sequence of Bluetooth handshakes lasting longer than 15 minutes from the first to last handshake and where there is a medium to high probability that at least one of the handshakes is within 1.5 metres.[26]

As per the COVIDSafe Health Officials Training [26](V15.4 PowerPoint), once an individual is confirmed to have COVID-19 (now a case) and consents to having their close contact data uploaded for contact tracing purposes, the process of uploading the case's close contact data by Public Health Officials is as follows:

- Log into the COVIDSafe Health Portal;
- Search for the case using their phone number;
- Generate a PIN and send it to the case's phone;
- Data is uploaded from case's phone;

- Review the close contacts of the case;
- Produce a final list of close contacts; and
- Contact or pass the list of close contacts onto the contact tracing team.

From a technology perspective, the COVIDSafe app was the correct tool to employ based on the parameters of knowledge and capabilities at the time of app launch. Many of the international contact tracing apps, such as Singapore's TraceTogether, similarly utilised BLE to capture digital 'handshakes' between mobile devices. The extent of the limitations of utilising BLE technology (discussed further below) to perform contact tracing for the COVID-19 situation were not known at the time of app launch because this particular use of the technology did not yet exist. Developing a BLE solution was also especially attractive at the time because user privacy was paramount, so privacy intrusive alternatives (such as a geolocation tracker) were rejected.

One Commonwealth employee noted that you needed the privacy controls to get the public take up, but the controls could have undermined the delivery of the app. The COVIDSafe app was designed with user privacy and security as the highest priorities (enshrined in specific legislation) and these have been adhered to. The data is stored locally on the smartphone, the data can only be uploaded with explicit permission from the user and the only identifiable information captured is the user's phone number (as the name can be a pseudonym). This stored information is all end-to-end encrypted and cannot be read unless it's passed into the National COVIDSafe Data Store. COVIDSafe was updated on 7 September 2020, primarily for security reasons (replay attacks) but also had the additional benefit of further improving user privacy.[27]

In terms of the security of the National COVIDSafe Data Store, the COVIDSafe project has also complied with best practices by hosting the data store on an Amazon Web Services (AWS) cloud platform. AWS has military grade security in place and as per the contract between the Australian Government and Amazon, AWS has no access to the encrypted information from COVIDSafe and the data cannot leave Australia.[28] It is a punishable criminal offence to hold COVIDSafe data outside of Australia, disclose COVIDSafe app information to any persons outside of Australia or use the information for any other purpose than state/territory health officials performing contact tracing[29].

As previously mentioned, COVIDSafe was designed to make users' mobile devices proxies for face-to-face contact and capture these encounters to assist in manual contact tracing processes. To that end, the app accomplishes what it was intended to within the parameters of technology, although as we discuss below there were technical limitations that constrained its effectiveness.

The National COVIDSafe Data Store

The National COVIDSafe Data Store was designed to store case contact data once a user is confirmed to be COVID-19 positive and has consented to have their contact data uploaded. It has also been demonstrated that the National COVIDSafe Data Store is capable of receiving and uploading encounter data from users. However, there were some issues with accessing data as state contact tracers mentioned that sometimes 'there was no data to upload', it was unclear whether this was because of an issue with the datastore, an issue with the app itself or behavioural and based around how users use the app on their device. Other issues with the public health portal included the complexity of the information provided to contact tracers, mostly during the period immediately after COVIDSafe launch which was subsequently improved. All state stakeholders noted the responsiveness of the DTA and DoH COVIDSafe teams, which undertook research with contact tracing teams in Victoria, NSW, Queensland and Western Australia to identify opportunities for improving their interface with the health portal[30]. They also acknowledged that substantial improvements were made in how the information is filtered and presented to PHUs, making it a more user-friendly process. This engagement should be continued to make further enhancements that align with the needs of the contact tracers and encourage ongoing use.

To safeguard users' privacy and comply with legislation, COVIDSafe was designed and built with stringent data access protocols in place to prevent automatic data exchanges. Data exchanges require the states to ensure they have adequate privacy protection legislation and processes in place and, as a result, need to be manually performed. To further illustrate the extent of the constraints, even for the purposes of this evaluation, de-identifiable data for basic variables such as the demographic profile of users could not be secured. In interviews with the state contact tracers, they all agreed that these data access protocols resulted in a cumbersome and

inefficient process for them to access the information, which involves eyeing data on screen and then manually entering any information into the contact tracing team's management system or a spreadsheet.

According to state contact tracers, they 'eye ball' the web portal and write down the names of potential close contacts, and then cross reference the data with what they have in their system and in other places to see whether it's likely that what 1) they already know about it, so no further action is taken and 2) if it is a new contact, to talk to the individual and understand the nature of the interaction they've had with the case.

Our technology review did not include any analysis of the National COVIDSafe Data Store algorithms such as those used to classify 'close contacts' visible to PHUs (stable and sporadic) nor any others. With this caveat in mind, we conclude that the technology behind the COVIDSafe app and data store is appropriate to record and provide a list of digital encounters for an individual confirmed to have COVID-19 with these digital encounters serving as a proxy for personal contact, so long as there are no issues with the BLE technology, or other implementation issues as are discussed further in the effectiveness and efficiency sections.

In order to maximise the app uptake, the Australian government made the decision for the COVIDSafe app to not capture location data and this decision is likely supported by the privacy/location concerns demonstrated through the s47C, s47E(d) report and ABS survey. Based on the decision to not utilise location tracking, the choice to utilise BLE technology is appropriate. As intended, the COVIDSafe Data Store has strict privacy and data security protocols that safeguards users' data even at the expense of automatic data exchange with PHUs.

COVIDSafe Coverage

Available evidence shows a large number of people have voluntarily installed the COVIDSafe app and registered. However, during the reporting period there was not data provided that suggests how many are continuing to actively use it. DTA data (18 March to 13 October 2020) showed that registered users stood at 7,122,061. If we assume only one registration this represents 28% of the Australian population (of 26 million Australians, 91% have smartphones)[31],[32].

State	User registrations as a percentage of total
NSW	33%
VIC	29%
QLD	18%
WA	10%
SA	7%
TAS	2%
ACT	<1%
NT	<1%

App usage as defined by consumer research

s47C, s47E(d)

s47C, s47E(d)

Effectiveness

The primary purpose of COVIDSafe was to support contact tracing teams when State and Territory economies started opening after the first pandemic wave. Abt examined available evidence, primarily of quantitative nature, to analyse the effectiveness of COVIDSafe support to contact tracing teams across the three states; Queensland, NSW and Victoria.

Two key sets of data were available for the evaluation. One provided by the states and a second one provided by DTA. We had access to tabulated data on key indicators for Queensland, Victoria and DTA. NSW provided key indicators estimated in *the 'Interim summary evaluation of the effectiveness and utility of the COVIDSafe app as an integrated contact tracing tool for the COVID-19 response'* undertaken by the Kirby Institute, UNSW Sydney in collaboration with the NSW Ministry of Health[34]. We examined relevant metrics from both data sources for NSW and Victoria. For Queensland, numbers were too small for our analysis, so we have provided a high-level description of the number of cases and close contacts.

New South Wales

Since the launch of the app, a second wave of infections and an economy that remained open with relatively moderate social restrictions resulted in a relatively high potential of virus transmission in NSW. [35] University of Melbourne modelling showed that in the month of October and with the virus still circulating in the community, NSW with an open economy had a transmission potential of 0.93 vs. 0.56 in Victoria which was still under stage 4 lockdown. The virus transmission potential in NSW illustrates the heavy demands imposed on contact tracing and testing systems to continue managing the epidemic in an open economy, while also providing the ideal setting for examining the effectiveness of the app.

NSW interim evaluation data

1. State data from the NSW interim evaluation summarised in

Table 1 below show that from 4 May to 30 October 2020:

2. NSW recorded 620 cases acquired locally or interstate aged 13 years or older and 137 (22%) had the app activated for at least part of their infectious period;
3. App data was obtained for 67% of app-using cases (92). The majority of cases for which data were not accessed (31 out of 45) had been in quarantine during the entire infectious period;
4. NSW Health followed up a total of approximately 25,386 close contacts, that is an average of 41 close contacts per case;
5. COVIDSafe data obtained for 92 cases revealed 205 potential close contacts, that is, on average over two individuals flagged by the app per case;
6. During case interviews, contact tracers validated the app data, which resulted in 126 out of 205 potential close contacts (61%) not meeting the epidemiological and clinical criteria of close contact (referred to as 'false close contacts' by contact tracers);

7. As a result 79 individuals flagged by the app in NSW were assessed by contact tracers as true close contacts (39% of all app potential contacts). They represent 0.3% of the state pool of close contacts (25,386), a proxy for the positivity rate of the app, that is the ability to flag individuals who meet the clinical and epidemiological criteria of close contact;
8. With 79 true close contacts, the app identified 0.86 close contacts per case for whom data were accessed vs. 41 close contacts per case for the overall contact tracing sample; and
9. Out of those 79 app true close contacts 22%, that is 17 individuals, correspond to contacts not identified by standard contact tracing, a figure also quoted in previous parliament discussions [36].

Table 1 - NSW Cases and Close Contacts (4 May - 30 October 2020)*

NSW Cases and Close Contacts (04 May - 30 October)	Number (#) and percentage (%)
Manual contact tracing	
Cases	620
Close Contacts identified/followed up manually	25,386
Close contacts per case	41
Cases with app activated - As % of all cases	137 22%
COVIDSafe App	
Cases with app data accessed - As % of all cases - As % of cases with app activated	92 15% 67%
App Potential Contacts (Individuals flagged by the App as potential contacts)	
Potential contacts flagged by the app	205
App false close contacts - As % of app potential contacts	126 61%
App true close contacts - As % of app potential contacts	79 39%
True close contacts per case	0.86
True Close Contacts as % of all NSW close contacts	0.31%
New Contact	
App Novel close contacts - As % of app true close contacts - As % of all NSW close contacts	17 22% 0.07%
App contacts also identified by standard contact tracing - As % of app true close contacts	62 78%

*Locally or interstate acquired confirmed cases aged 13 years or older

Source: Evaluating the effectiveness and utility of the COVIDSafe app as an integrated contact tracing tool for the COVID-19 response – Interim results from NSW [34]

DTA COVIDSafe Report NSW

The DTA COVIDSafe report shows that since 26 April to 27 November 2020 in NSW:

1. 105 uploads were registered and 85% of those uploads (89) had at least one encounter recorded.
2. For those 105 encounters, 837 app-identified contacts were recorded, that is, 7.9 contacts per upload.

As noted in the DTA report, the list of potential contacts are calculated as a 'count of distinct relationships between uploader and contacts', and correspond to the 'number of potential close contacts identified when a PHO has uploaded the data of a positive case'.

It can be seen that there are important differences with the indicators provided by the NSW interim evaluation report. DTA data was only made available on 18 December 2020 and we were unable to discuss these differences with state officials. We only have access to aggregated data, so we are unable to clearly establish the source of the differences, which would require examining disaggregated information from both data sources. However, with a view to contribute to a future reconciliation of these figures by DTA and State representatives, we examine below the key differences and explore plausible implications.

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Victoria

In the second half of 2020, Victoria experienced a second wave of infections with tightened mobility restrictions brought about by the state government from mid/late June 2020.

Melbourne entered a stage 4 lockdown on 6 August 2020 just a few days after daily surges peaked near 700 cases.[37]

Mobility and social restrictions such as those imposed by Victoria aim at breaking the chain of transmission by bringing down contact rates between cases and other individuals. In such environments, people have fewer random contacts in close proximity and easily remember those individuals with whom they were in close contact and there was consensus in the consultations with state contact tracers that digital tools like COVIDSafe were not designed to support contact tracing in this context. With this caveat in mind, we examine below aggregated data from both data sources; state and DTA.

State Data

Victoria data in Table 5 show that from 1 May to 15 October 2020[38]

- Data on app-usage was collected for 67% of all cases acquired locally or interstate (12,609 out of 18,947). The remaining 6,338 cases (33%) were reported as having missing information.
- Out of the 12,609 cases with COVIDSafe information recorded, 1,833 cases (15%) reported using the app versus 10,776 cases (85%) reporting no app-usage. Similar proportions are observed when the sub-sample of cases over 18 years of old is used (16% of app-using cases vs. 84% reporting no use).

The state also provided data on the number of close contacts identified by the sub-sample of app-using cases (9,402 close contacts recorded for 1,833 app-using cases)[38].

All contacts were recorded as individuals already identified by standard manual contact tracing with no novel contacts identified through the app.

We note that progressively increasing mobility restrictions and social distancing measures were imposed since June and it is widely agreed that there is no expectation for the app to demonstrate effectiveness in these circumstances.

The state did not record information on the number of individuals flagged by the app that were found not to meet the criteria of close contact.

Table 5 - Victoria - Case Reporting of COVIDSafe Use (01 May- 31st. October 2020)

COVIDSafe Use *	Number of Cases
Yes	1,833 (15%)
No	10,776 (85%)
Sub-total of Cases with COVIDSafe Use information	***12,609***
Cases with Missing information	6,338
Total	**18,947**

*Locally or interstate acquired confirmed cases; Source Victoria State Government 2020, Data on COVID-19 Cases, Close Contacts and COVIDSafe, provided to the evaluation team[38]

DTA COVIDSafe Report Victoria

The DTA report data for Victoria shows:

- 625 uploads and 75% with encounters registered (466); and
- 1,667 potential close contacts were identified, that is 2.7 per upload.

The research team do not have state level data on the number of individuals flagged by the app, who were reviewed by contact tracers and the proportions that meet the criteria of close contact versus false close contact.

We are thus unable to gauge the extent to which information on close contacts provided by DTA aligns with the numbers that contact tracers reviewed and validated on screen. However, we briefly examine below the large differences observed in terms of uploads and cases with information on app-usage recorded between the two data sources.

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Queensland

During the second wave of the pandemic, Queensland closed state borders and progressively relaxed social and mobility restrictions between May and November 2020 for residents within the state. The state showed very low levels of community transmission with only 60 confirmed cases locally or inter-state acquired in the period 1 May to 15 November 2020.

The contact tracing team identified 4,273 close contacts, an average of 71 per case.[39] However, the sample of app-using cases was too small for reporting.

Indicatively there were less than five cases reported using the app in the data from Queensland. For the sub-sample of cases over 18 years of age (48), this represents a proportion of app-using cases in the range **of two and eight percent.** Possible reasons for this include the number of pre-conditions required for the COVIDSafe to work effectively (incl. phone settings) and a high proportion of potential contacts not meeting the COVIDSafe business rules for data to uploaded to the National Datastore.

In summary, numbers in Queensland are too small for an analysis of the app effectiveness and the social distancing. Finally, mobility restrictions in Victoria are not conducive for examining the effectiveness of a digital contact tracing tool aimed at supporting the identification of individuals in close proximity to the case.

However, available data from NSW suggest limited effectiveness of the app, even after allowing for differences in data sources. We explore below some of the potential barriers to app effectiveness.

Effectiveness Drivers

At the most basic level, the effectiveness of the app is predicated on its ability to identify individuals who meet the criteria of close contact and according to the Series of National Guidelines (SoNG) for Public health offices, [40] *"a close contact is defined as requiring":*

1) *face-to-face contact in any setting with a confirmed or probable case, for greater than 15 minutes cumulative over the course of a week, in the period extending from 48 hours before onset of symptoms in the confirmed or probable case, or*

2) *sharing of a closed space with a confirmed or probable case for a prolonged period (e.g. more than 2 hours) in the period extending from 48 hours before onset of symptoms in the confirmed or probable case."*

Note: this report is not designed to provide an extended analysis of the definition of close contact, but rather to examine barriers for COVIDSafe to support the identification of these two different types of close contact as framed within the SoNG and relevant complimentary state guidelines.

Face-to-face contacts

Face-to-face contacts are the primary target of proximity apps like COVIDSafe. The app's current business rules allow for recording of digital handshakes when other app users are in close proximity (i.e. within 1.5 meters). However, encounters between two individuals are only logged if during the last 21 days there has been at least one single encounter lasting over 15 minutes, excluding the one-week cumulative rule in the current guidelines.

We should note that the cumulative rule was introduced in SoNG Version 2.5.1 on 17th of April, just a few days after the announcement that the government was developing COVIDSafe. The COVIDSafe algorithm rules are not and were never based on the Communicable Disease Network Australia's (CDNA) SoNG, but rather those set out by the AHPPC.

Data was not available to examine the extent to which a considerable or relatively minor proportion of close contacts would fall in the app excluded category (i.e. over 15 minutes cumulative over a week but without a single 15-minute encounter).

However, interviewees noted that routine face-to-face contacts meeting the cumulative criteria are likely to be easily remembered by the case during standard contact tracing interviews, and suggested that for them there might be limited added value in improving the app business rules by incorporating the cumulative criteria.

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Technology review: Bluetooth handshakes as proxy for face-to-face contacts

The COVIDSafe app utilises BLE technology, cryptography and does not require any integration with other apps to perform its function. However, several technology related issues might prevent smartphone users from installing the app or prevent the installed app from registering handshakes that act as a proxy for face-to-face contact.

The COVIDSafe app relies on users selecting the right phone settings for both iOS and Android devices. On Android and iOS devices, the COVIDSafe app is not able to function properly (i.e. register handshakes) without having Bluetooth enabled, this is also true of the COVID-19 Google and Apple Exposure Notification Framework (ENF) and so is a challenge for all Bluetooth contact tracing apps.

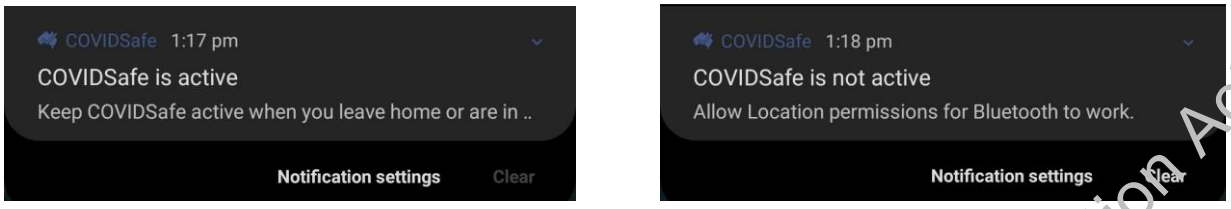
For Android phones, location services also need to be enabled and for all phones the app either needs to be open and active or running in the background. For some users This means there is a level of user compliance required as a pre-requisite for the app to work effectively and this has not always occurred and is an inherent risk for the effective operation of COVIDSafe. Location services also need to be enabled for Android users because Google requires location permissions for Android apps to access Bluetooth.[41] This may also be part of the reason that the number of app registrations has not translated into a high number of potential close contacts who have COVIDSafe data when contacted by state contact tracing teams, and further investigation on this is warranted.

However, it is a very common misconception that the app records location s47C, s47E(d) which found that 57% of people surveyed believe the app tracks their location and collects location data. This misunderstanding likely resulted in lower engagement with the app, particularly amongst key demographic groups such as young people, which s47C, s47E(d) notes is a key barrier to be addressed if more people are to be encouraged to actively use the app.

In order for the COVIDSafe app to function optimally (i.e. registering handshakes), it either needs to be open and active or running in the background. On Android devices, the app can be safely closed, and it will continue

to register handshakes in the background, as per the permanent notification in the notification tray. This permanent notification also informs the user when the app is inactive and handshake registration cannot occur.

Figure 1 - COVIDSafe active/not active notification on Android devices



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Technology writer James Vincent[47] wrote in May 2020 that this issue of Bluetooth broadcasts (in the background) was known at the time of the app launch:

> *Both Google and Apple restrict how apps can use Bluetooth in iOS and Android. They don't allow developers to constantly broadcast Bluetooth signals, as that sort of background broadcast has been exploited in the past for targeted advertising. As others have reported, iOS apps can only send Bluetooth signals when the app is running in the foreground. If your iPhone is locked or you're not looking at the app, then there's no signal. The latest versions of Android have similar restrictions, only allowing Bluetooth signals to be sent out for a few minutes after an app has closed. Such restrictions will block*

devices from pinging one another in close quarters, drastically reducing the effectiveness of any contact-tracing app.

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Figure 3 - The DTA's COVIDSafe Bluetooth Encounter Logging Results

COVIDSafe Bluetooth Encounter Logging Results

As at 26 May 2020

	Android to Android	Android to iOS	iOS to iOS
	Galaxy S10 – Note 9	Galaxy S10 – iPhone X	iPhone X – iPhone 6s
Active -> Active	Excellent	Excellent	Excellent
Active -> Background Unlocked	Excellent	Good	Excellent
Active -> Locked	Excellent	Moderate	Good*
Locked -> Locked	Excellent	Moderate	Moderate

As at 14 May 2020

	Android to Android	Android to iOS	iOS to iOS
	Galaxy S10 – Note 9	Galaxy S10 – iPhone X	iPhone X – iPhone 6s
Active -> Active	Excellent	Excellent	Excellent
Active -> Background Unlocked	Excellent	Good	Excellent*
Active -> Locked	Excellent	Moderate*	Moderate
Locked -> Locked	Excellent*	Moderate*	Moderate*

As at 26 April 2020

	Android to Android	Android to iOS	iOS to iOS
	Galaxy S10 – Note 9	Galaxy S10 – iPhone X	iPhone X – iPhone 6s
Active -> Active	Excellent	Excellent	Excellent
Active -> Background Unlocked	Excellent	Good	Good
Active -> Locked	Excellent	Poor	Moderate
Locked -> Locked	Good	Poor	Poor

Encounter logging: Excellent (80% to 100%), Good (50% to 80%), Moderate (25% to 50%), Poor (25% or below)

* Improved performance from previous testing

Enclosed settings

Individuals sharing enclosed spaces are not the primary target of proximity apps like COVIDSafe, but of attendance registration or 'check-in' apps, which facilitate the recording of people attending public venues such as cafes and restaurants[48]

Enclosed environments provide a heightened risk due to airborne transmission and various factors including poor air ventilation and extended exposure periods. [49],[50]. The basic rules of the definition (enclosed space and exposure of more than two hours) were current at the time of the app launch, though as late as June 2020, the risk of airborne transmission, except for aerosol-generating procedures performed in health care was not recognised by most public health organisations, including WHO. Evidence however was mounting that airborne transmission in enclosed, crowded environments with inadequate ventilation appeared to be the only plausible

explanation for several super-spreading events. This prompted calls for governments around the world to take firmer action to prevent virus transmission in these settings, including moving activities outdoors. [51,52]

Current NSW and Victoria guidelines reflect the heightened risks posed by enclosed spaces.[53,54], and ample media coverage of large outbreaks linked to this type of setting have shown the Australian public their potential for rapid virus transmission[55]. For contact tracing teams 'never fall behind', digital contact tracing supports, including contact tracing apps are a must in this type of settings if large numbers of potential contacts are to be rapidly identified and quarantined[48].

Although not the intended target of COVIDSafe, at least in theory, the app could be useful in identifying individuals that shared a closed space and in some instances it could even provide useful information for contact tracers to unveil unreported exposure sites that the case failed to mention during a standard contact tracing interview. This was indeed the rationale for describing validation of close contacts as one of the key benefits of the app. On the other hand, risk exposure in this type of settings happen even when contacts maintain physical distancing from a case (i.e. over 1.5 metres), resulting in a substantial number of exposed individuals excluded from COVIDSafe business rules identification.

Both the potential benefit for COVIDSafe to uncover unreported exposure sites with potential to become hotspots can be illustrated by the following example which was provided by Commonwealth staff and was commonly referred to as the Mounties example in the media[56]. A previously unreported exposure at a venue assessed as high risk was identified from COVIDSafe data. In addition to several close contacts present at the venue who were identified directly from the App, 544 close contacts were identified from a venue sign-in list and requested to self-quarantine. Two of those contacts subsequently tested positive to COVID-19.

These new cases linked to this venue may have been unveiled in subsequent interviews, and the failure to identify those two close contacts that tested positive could have led to a 'super-spreader' event that highlights the benefits of COVIDSafe to supplement contact tracing. However, as noted by the s47C, , effective contact tracing in this type of setting requires both location data and personal data which is only recorded via check-in lists at present. This suggests the app (which doesn't record location) may not be as efficient for supporting contact tracing in this context, which is now a key priority for contact tracing but was never the intended purpose of the app.

Very high-risk environments where digital tracing tools may yield additional benefits

In September 2020, the Australian Health Protection Principal Committee released a statement on very high-risk environments which carry the risk of COVID-19 transmission due to a wide range of factors including large numbers, crowding and queuing, surfaces with multiple high touch points, close proximity, loud volume singing, multiple venues operating at the same time, people visiting multiple venues and people attending from or returning to regional areas. [57] Very high-risk settings include typical indoor venues discussed above, such as restaurants, bars and nightclubs as well as large unstructured outdoor events such as music festivals, food festivals, schoolies graduation festivals, carnivals, community sporting events and other un-ticketed spectator events. These settings can easily become hotspots for large outbreaks and potential super-spreader events where many individuals can become infected on one occasion[58]. s47C, we also observed during our interviews, that state contact tracing teams identified enclosed settings as a key priority gap in standard contact tracing that would need the support of digital tracing tools, such as attendance registration apps or COVIDSafe like technology options. However, in its current form, COVIDSafe is not able to be used effectively for these purposes due to the identified constraints already discussed above.

Along similar lines, the other type of setting in which technology aids with area tracing capability would provide additional benefits are unstructured settings such as supermarkets, major retail shops, shopping centres, community shared facilities and unstructured community gatherings not easily amenable to attendance registration apps. Contact tracers use a combination of approaches including aide-memoire tools as well as social and mass media messaging that rely on identification of specific locations and times visited by the case. As noted by one of our interviewees:

The second piece (for) any technical solution, needs to not only include the potential close contacts, but a connection to support jurisdictions with the check-in functionality, like the venue check in, which predominantly is QR stuff, but it also allows us to keep a better handle on movements of people in social settings and quickly get access to that data if we need to, to 1) talk to them legitimately as close contacts, but 2) to also send out broadcast comms and media updates to, keep a track of where people are, if we need to get in contact with them quickly (Contact tracing team staff member)

Finally, s47C, s47E(d) , efficient contact tracing relies on the accurate memory recall of cases and jurisdictions have been relying on information stored on cases' smartphones like diaries, GPS coordinates and time stamps of photos to help refresh their memories[48]. In theory COVIDSafe could also prove beneficial in at least some of these circumstances. However, as noted in DoH training materials, information on the phone number and name of individuals identified by the app should not be revealed to the case[50], which makes the task of leveraging the app information for refreshing people's memories, validation or eliciting new information somewhat onerous.

The app has identified less than two percent of the total pool of close contacts identified in NSW and no new contacts were identified by COVIDSafe in Victoria or Queensland between March and November 2020. COVIDSafe has technology constraints, complications with manufacturer phone settings, and there are limitations to its use in high-risk settings. Overall, the state contact tracers interviewed for this report have suggested it has not been a highly effective complementary tool for their state contact tracing systems.

Efficiency

The rationale s47C, s47E(d) emphasised the importance of rapid contact tracing for bringing a return to 'normal' economic activity as well as the need to reduce the time elapsing from patient testing to quarantine of their close contacts to fewer than 48 hours[48]. This was also reflected in the original intent of the COVIDSafe app, which was to contribute to a more rapid, effective and efficient contact tracing process.

During our interviews, the primary users of COVIDSafe, the state contact tracing teams, have noted that the time required to undertake the various COVIDSafe tasks adds to their workloads without optimisation of benefits. Available data from NSW examined in the previous chapter, show that out of 205 individuals flagged by the app, 61% (126) were 'false close contacts', 30% (62) were individuals already identified by standard contact tracing and the remaining 9% (17) were novel contacts.

So, inefficiencies arise because while all app potential contacts need to be validated by contact tracers, a significant number of those individuals are either 'false close contacts' or individuals already identified by standard contact tracing. This is compounded by existing processes to access datastore information. We examine each of these issues below in more detail.

Verifying information on potential close contacts flagged by the app

During the case interviews, contact tracers ask cases whether they are a COVIDSafe user or not. Contact tracers then proceed to secure consent to upload their data to the datastore and request the pin for uploading. If users are in quarantine, then this process is not always followed, due to the lack of exposure. According to interviewees, this process usually happens relatively smoothly and without delays, although in some rare instances uploading might fail and has to take place at a different time. Once data are uploaded, contact tracers must review and validate the app contact information on screen, which involves cross-checking it against the list of close contacts secured during the interview and flag those ones listed in the app, but who have not been identified by standard contact tracing.

Contact tracers need to verify information for each individual to establish the circumstances of registered encounters and assess whether the person has been at risk of exposure or not. In line with the training materials and the COVIDSafe legislation to avoid privacy breaches that can easily happen if contact tracers let slip the name of a person that has not yet been provided by the case, extreme care needs to be taken during the interview to verify the information of these potential contacts. Contact tracers would for example start

enquiring about the whereabouts of the case at the time of the encounter listed by the app and would establish if given the circumstances, the individual flagged by the app was at risk of exposure or not. So even though a concurrent use of the health portal might in theory be an efficient way of embedding COVIDSafe into existing contact tracing processes and leverage COVIDSafe[60], a case interview usually needs to happen first and it is used to verify if individuals flagged by the app were at risk of exposure, without privacy breaches.

False close contacts and technology barriers

Those individuals who are assessed as not being at risk of exposure are classified by state contact tracers as 'false close contacts'. In line with the nuances of contact tracing, some instances of 'false close contacts' are easily verified during the interview as the examples provided by Victoria stakeholders who noted that a pattern emerged of individuals listed by the app who had registered encounters with the case that lasted from late at night to early in the morning and who happened to be neighbours living in attached dwellings separated by a wall and at no risk of infection.

In other instances, the validation process is more involved and resource intensive. For example, Queensland stakeholders described a situation requiring validation of multiple encounters registered by the app that happened to take place during a waiting queue for COVID-19. Contact tracers had to reverse engineer the line-up using lab registrations and cross-reference them and they finally established that approximately 17 to 18 individuals flagged by the app were not at risk of exposure since they were not in close proximity to the case for 15 minutes or more.

Our evidence suggests that most 'false close contacts' were individuals listed by the app as meeting the criteria of face-to-face contact as they were likely to be within 1.5 meters of the case for 15 minutes or longer, but after investigation by contact tracers, most of them were found to be physically separated from the case.

In addition to false close contacts being physically separately, other issues are technology related; the first of these is that Bluetooth technology is not consistent between phones; and the second possible explanation is that the Received Signal Strength Indication (RSSI) can vary substantially depending on a variety of factors.

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s47C, s47E(d)

Inefficiencies associated with current processes for accessing datastore information

As part of their quality improvement processes for an agile product like COVIDSafe, in August 2020, DTA undertook research to better understand how state teams use the COVIDSafe Health Portal to complement their existing contact tracing processes. They examined how contact tracing processes varied across states and identified constraints and opportunities for improvement, including those related to how the data are presented to contact tracers. State stakeholders noted that substantial improvements have been made to the health portal that de-emphasise technology-specific content that contact tracers found confusing and facilitate the use of the information during interviews[64].

However, the report also noted that the process of accessing the health portal is manual and takes time[64], which contributes to system inefficiencies. Without a data exchange facility for contact tracers to easily access COVIDSafe contact data, all information needs to be examined on screen and manually entered into their own systems and spreadsheets. Contact tracers are not able to download the data into a CSV file (due to privacy issues which are still being worked through), which would in their opinion, "allow them to analyse and validate information in a less cumbersome way."

As one contact tracer said:

> *What would be most valuable from (COVIDSafe in the future), if you get a list of, by numbers out of the app directly, we cross reference that with a list, that comes out of the case interview, because then we could cross off all the people that we already knew about really quickly. And be left with a subset of contacts that we had that hadn't emerged through the manual contact tracing process. But…that's not an option because of the privacy and security constraints that are implemented with the use of the system.*
>
> *(Contact tracing team staff member)*

We do not have data to estimate time spent by contact tracers uploading, analysing and validating the potential close contact information provided by COVIDSafe, but the current COVIDSafe interface adds another layer of tasks to contact tracing teams who need to manually validate and analyse information on individuals flagged by the app, drawing on data that they have already secured through their standard contact tracing. The contact tracers interviewed each gave their own estimates as to the amount of extra time they spent accessing and analysing the data from the National COVIDSafe Data Store; some of these estimates were as long as 2 hours.

In the current environment, where PHUs must be ready to rapidly surge their capacity and where it is widely acknowledged that experienced contact tracers are at the core of a good system and cannot be easily outsourced or secured through short term training[48], inefficient use of contact tracers' time is a high cost for the

system to bear. Since experienced contact tracers are currently in high demand and face scarce supply, any additional task required from them that does not deliver substantial benefits carries considerable opportunity costs, as some of the following state contact tracers (who are the ultimate customers of the app) have described:

> *And there's a lot of work to squeeze out that value out of what's there, which detracts from a scarce resource that could be doing boring, but legitimate manual contact tracing work to identify high-risk household contacts and to, you know, get the case of support they need and to do all of the other stuff that we're doing.*
>
> *(Contact tracing team staff member)*
>
> *I think it's most useful in settings where there's no registration, possibly like bus or a subway or a train carriage would be effective….but at this point it hasn't … identified a lone person on a seat behind someone on a bus or a subway carriage or something*
>
> *(Contact tracing team staff member)*

Overall, the utilisation of COVIDSafe has resulted in high transaction costs for state contact tracing teams and produced few benefits and efficiencies to the existing contact tracing work-flow.

Conclusions

As countries around the world grappled with the dire economic consequences of lockdowns, there was increasing recognition that as economies started opening again, digital tools were required to support contact tracers and effectively manage the pandemic[65]. s47C, s47E(d)
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As our technology review indicates, based on the parameters of knowledge and capabilities at the time of app launch, it is believed that the COVIDSafe app was the correct tool to employ. Many of the international contact tracing apps, such as Singapore's TraceTogether, utilised BLE to capture digital 'handshakes' between mobile devices. The limitations of utilising BLE technology to perform contact tracing were not known at the time of app launch because this particular app of the technology did not yet exist. Utilising a BLE solution was also especially attractive at the time because user privacy was paramount, so privacy intrusive alternatives such as a geolocation tracker were rejected.

Stakeholders agreed that the intended objective of the app which focused on providing safeguards to open the economy were beneficial. All stakeholders acknowledge the challenges at the time of the app development, which involved producing a new digital contact tracing tool, for a new virus, and in a context of evolving epidemiological and technological evidence. To do it in a matter of weeks and under intense public scrutiny to safeguard both public health priorities and individual privacy rights was a commendable achievement.

We have found limitations in both the effectiveness and efficiency of COVIDSafe for contact tracing efforts and acknowledge that even with a vaccine, COVID-19 will remain a challenge for some time. In this context, we believe it is crucial for all state and commonwealth stakeholders to explore options for enhancing COVIDSafe, particularly in regards to the seven million Australians that have downloaded the app, while recognising the real performance barriers that are limiting the effectiveness and efficiency of COVIDSafe.

We hope these evaluation findings can be used to inform discussions with state contact tracers on future improvements to COVIDSafe. We further advise that noticeable improvements to COVIDSafe should occur and be demonstrated through the continued involvement of states and territory public health officials in user testing (the workflow of the datastore, integrations with state contact tracing systems and the utility of the app), to ensure continued support of the app.

Appendix 1: Singapore's TraceTogether and SafeEntry

Early in the pandemic, Singapore was at the forefront of contact tracing apps. The Singaporean government developed an open-source app protocol called OpenTrace/BlueTrace which was eventually developed into the country's national contact tracing app, TraceTogether on which the COVIDSafe app was based. The development of a COVID Bluetooth app was pioneered by Singapore with their TraceTogether app, released on 20 March 2020.[66] If a person was diagnosed with COVID-19, they could permit the Ministry of Health access to their TraceTogether Bluetooth proximity data to support the contact tracing of those who were in close contact with the diagnosed app user. Developers were open about the technology not replacing manual contact tracing but rather complement - a combination of centralised contact tracing and follow-up, and this could never replace human involvement.[67] Their adoption of a 'hybrid model' of a decentralised and centralised approach was highlighted as being specifically built for Singapore and what was felt to work best for their population and economy.[68]

In the first 24 hours, TraceTogether app received half a million downloads. A month later, an estimated 1.1 million users had downloaded the app, with an adoption rate of 20% of the population.[69] The TraceTogether technology was quickly adopted around the world by countries such as the United States, South Korea, India and Israel.[70] However, Singapore changed direction shortly after and began adopting more traditional public health strategies. The download rate plateaued despite the demonstrated efforts to advertise the technology as being a 'privacy-by-design' model (designed with data storage on the users phone for 21 days and then deleted).[71] This stall in downloads brought to the forefront the concerns around the app's privacy and people's motivations, along with other complaints such as battery drainage.[72] Despite these concerns around app privacy, the TraceTogether app does not record or send any user location data[73]. The COVIDSafe technical review team has directly examined the source code for BlueTrace/OpenTrace, the code base for TraceTogether, and can confirm that no location data is recorded or sent.

TraceTogether released an update in July 2020 that the Singaporean Government claimed had resolved the iOS Bluetooth issues. TraceTogether also developed a standalone beacon device, called the TraceTogether token, that performs and manages the contact tracing, without needing a smartphone. The main objective of this TraceTogether token was to enable the 5% of the population without smartphones, such as young children and the elderly (one of the most at-risk demographics) to participate in contact tracing. As of 25 October 2020, more than 400,000 TraceTogether tokens have been collected which, when combined with the TraceTogether app downloads, totals about 50% of the Singaporean population participating in contact tracing.[74]

Singapore also adopted other means of tracing potential contacts, particularly where significant time was being spent in public places. This was predominately achieved via the scanning of an individuals' national identity, employment, or work permit card supported by the Government and an app called SafeEntry.[75] In addition, Singapore has also been reported as using media such as video recordings and surveillance of public locations to cross-check contract tracing lists – a practice which would not be permissible under Australian privacy law.[76] As of September 2020, TraceTogether tokens can be used for check-in to SafeEntry, so users only need to scan their tokens without needing to manually enter their details.

The Singaporean government has announced that as of December 2020, either TraceTogether or the TraceTogether token will be mandatory to gain access to public venues such as restaurants, workplaces, schools and shopping malls. Because of this, more than 4.2 million people (78 percent of the Singaporean population) are now using either the TraceTogether app or token and this number is only expected to increase as distribution of the tokens resumes.[77] The required use of TraceTogether to access public venues has been pushed back due to distribution shortages of the TraceTogether token and is expected to be officially instated sometime in January 2021.[77]

Appendix 2: Stakeholder Engagement

Key Stakeholder	Key Staff / Areas / Departments	Consultation Type	Sample Interviewed
State/Territory Governments	State public health officers from the respective Department of Health.	Key Informant Interviews Group interviews	8
Public health offices	Based on the advice of DoH focusing on several Public health offices to conduct case studies and scenario plans to understand contact tracing efforts	Key Informant Interviews Group interviews	3
Commonwealth Agencies	Department of Health Digital Transformation Agency	Key Informant Interviews Group interviews Document review	8
Subtotal	Total number of group and key informant interviews (14) and participants (19)		19

Appendix 3: Data sets reviewed

Datasets used in this evaluation as well as key reports were provided directly by DTA or DoH, jurisdictional public health offices, and the following kinds of information and metrics were referenced:

- DTA summary of COVIDSafe metrics
- Registration data
- Information on changes to the 15 min rule algorithm
- Enterprise testing and assurance
- Enhancements to COVIDSafe

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- Qualitative data from state contact tracing teams
- Training presentation for state contact tracing teams
- NSW, VIC QLD case numbers, cases reported using app, confirmed cases, close contacts

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